CBDA INDEPENDENT SCIENCE BOARD
LEVEE INTEGRITY SUBCOMMITTEE
DRAFT RECOMMENDATIONS

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Background

These recommendations of the ISB Levee Integrity Subcommittee (hereafter the Subcommittee) are based on our review of a paper by Mount and Twiss of the ISB (Mount and Twiss, 2005) dealing with the potential for catastrophic levee failures due to seismic activity, flooding and subsidence, additional fact-finding by subcommittee members and our discussion during several subcommittee meetings. CBDA, DWR and other agency personnel have been helpful in providing copies of reports and keeping us informed of ongoing discussions regarding levee system integrity. The subcommittee is aware that addressing levee integrity is considered a high priority by the Authority and recognizes that any detailed recommendations of the ISB may rapidly be over taken by events. Consequently, the subcommittee has focused on long-term scientific needs associated with furtherance of levee integrity and mechanisms which can be used to assure the Authority that their decisions and policies are informed by the most current scientific understanding of the issues involved.

Findings

1. The Mount and Twiss (2005) report has played an important role in focusing attention on the interface between the goals and objectives of the CBDA programs and the potential for catastrophic levee failure due to some or all three of the forces identified in the report. The report also assigns probabilities to sets of exceedences for various events, and concludes that there is approximately a .67 probability of either a 100 year flood exceedence or a 100 year earthquake during the next 50 years. These events are expected to cause dramatic changes within the infrastructure of Delta levees, and result in associated effects to land uses, ecosystem services and the ability of the state to deliver water to contractors. The report concludes by noting the need for additional studies into the physical and economic feasibility of alternatives to current policies and programs to protect and maintain the levee system. *The ISB agrees with the authors that a "business as usual" approach embeds high risk to stakeholders and to society.*

2. The specific risk of levee failure due to seismic activity was assessed by Torres et al. (2000). This report highlights areas of greatest risk within the general system of Delta levees and performs a series of scenario analyses to simulate levee breaching under different magnitude and

location of earthquakes. The assessment is generalized in nature due to the lack of specific soil and substrate information available for Delta levees and some uncertainty regarding the location of specific fault structures near the Delta. *The ISB recognizes that one of the key uncertainties in assessing the risks associated with Delta levee fragility is the limited extent of geotechnical information.*

3. A recent study of the economic consequences of catastrophic levee failure (Illingworth et al, 2005) was funded by DWR. While the report is exploratory in nature and is structured as a deterministic analysis of two hypothetical events (simultaneous breaching of 30 or 50 levees in mid-summer), it does provide the first assessment of the potential costs to stakeholders and taxpayers in California should events described in Mount and Twiss or in Torres et al come to pass. Specifically, the study estimates costs to agricultural users in the San Joaquin valley to range from $300 to $500 million (in 2003$), while costs to urban water districts and their customers will range from $500 to $3,000 million, depending on the scenario. These costs do not reflect costs to Delta agricultural lands, to infrastructure and to ecosystem services. Thus, these estimates are viewed by the authors as lower bounds on the economic consequences of the two scenarios evaluated. Despite the uncertainties inherent in the estimates, the substantial magnitude of the damages reported in Illingworth et al. can inform policy makers as to whether this is an issue of high priority for action and can suggest where additional information is needed in terms of assessing alternative policy responses. *The ISB appreciates that potential costs of levee failure are significant; responding to such events after the fact would impose severe financial stress on state resources.*

4. Within this technical context, the passage of the Calfed Bay-Delta Authorization Act (HB 2828) in 2004 states "the Secretary of the Army is authorized to undertake the construction and implementation of levee stability programs or projects for such purposes as flood control, ecosystem restoration, water supply, water conveyance, and water quality objectives.". The Act also calls for the Corps of Engineers to submit a report that describes the levee stability reconstruction projects and priorities that will be carried out during each of fiscal years 2005 through 2010. While the Act authorizes $90 million for levee stability activities, existing appropriations for this work are minimal and thus far have been insufficient for the Corps to even complete the report. *The ISB agrees that levee stability projects are multi-purpose in nature but notes that the current authorization of federal funds is unlikely to completely address the problem.*

5. Several ongoing activities by the CALFED Levee System Integrity Program and associated agencies are addressing some of the issues raised in Mount and Twiss (2004). These include:

- Findings from the Torres et al. (2000) report have been used by CALFED to identify and prioritize areas of emphasis within the levee management and mantainence program, including selection of eight western Delta levees for reengineering to protect water quality and environmental values.
- DWR is initiating follow-up economic studies to Illingworth et al. (2005) to 1) investigate the economic losses from levee failure under a probabilistc framework which includes a broader range of options and to 2) assess the cost-effectiveness of alternative actions to allow decision makers to understand the tradeoffs between costs of Delta levee management actions and the outcomes of those actions.

- DWR has performed a series of hydrodynamic analyses of levee failures on Delta salinity changes.
- DWR initiated the Delta Levees Seismic Risk Analysis in 2003 to develop a risk model of Delta Levee failure and the consequences of such failure for Delta export water quality.
- DWR has engaged in studies to advance the scientific understanding of subsidence and has performed demonstration projects for establishing Best Management Practices (BMP's) to slow Delta subsidence.
- The Ecosystem Restoration Program Plan (ERPP Vol. II) includes several actions to involving various degrees of flooding of Delta islands which will likely reduce the future rate of subsidence on some Delta islands. Such projects seek to provide non tidal perennial habitats and one of the key uncertainties in assessing the risks associated with Delta levee fragility is the limited extent of geotechnical information. Creation of tidal wetland habitat in appropriate areas can also reduce subsidence rates. Further emphasis on the habitat value of working landscapes in the Delta, especially uses that include flooding of soils during summer months, may also reduce oxidation of peat soils.

The ISB acknowledges the magnitude of effort currently being devoted to addressing Delta levee instability and subsidence by various Calfed programs and agencies.

6. DWR has recently initiated a Delta Risk Management Study which will address the ecological as well as economic consequences of levee failures. Scoping for this study has involved a variety of agencies and stakeholders and a Technical Advisory Committee has been formed to guide the development of specific study tasks. *The ISB supports the efforts of DWR in moving this study forward so quickly, and is gratified to see the broad scope envisaged for the study*.

7. Lack of interim policy regarding levee failure, pending completion of Risk Management Study (2 years away at best). Helen??

Subcommittee Recommendations

The Levee's subcommittee propose a set of recommendations to the CBDA which will assist the CALFED agencies in 1) enhancing our understanding to the inherent risks posed by the levee system to water quality, ecosystem processes and economic activities, 2) identifying long term, economically feasible solutions to the challenges presented by the probability of levee system failure and 3) ensuring that studies and reports used to support decisions and policies reflect current scientific understanding of the factors influencing levee failure.

1. Enhanced Understanding
    a. The Illingworth et al study places the events described in Mount and Twiss and Torres et al in an economic context. To make these findings more relevant to the understanding of the consequences of levee failure for society, **the Subcommittee recommends additional economic studies that link actions to outcomes**. DWR is considering additional economic assessments (cost-effectiveness analyses) under the DRMS. These studies need to address the issue of economic valuation of damages/costs in a probabilistic framework. In addition, we recommend that a broader range of effects needs to be included in future

economic assessments, such as effects of levee failure on Delta infrastructure, agricultural lands, and ecosystem services associated with both the Delta in general and the CBDA investments in ecosystem restoration in particular.

b. The Delta Risk Management Study must encompass all available information to inform the development of a strategic plan. **The Subcommittee recommends that DWR and COE in collaboration with the Science Program and members of the ISB conduct one or more workshops** to 1) focus on the state of the knowledge associated with levee integrity (e.g., assessing geotechnical data on embankments and foundations, known or historic areas of levee instability, and identification of significant gaps in information that hinder risk assessments), and 2) evaluate a range of possible management strategies and policies using hypothetical scenarios.

c. Planning for and responding to levee fragility within the Delta will require significant improvements in geotechnical information. The complexity and costs associated with developing adequate geotechnical information preclude a rapid response to and resolution of this issue. **The Subcommittee recommends that, as a high priority product, the DRMS should develop a multi-year plan for addressing data gaps, prioritizing data collection, and incorporating or assimilating new information into risk assessments.**

2. Development of long-term economically feasible solutions
    a. Long-term solutions must fully embrace actions of all program elements and non-CBDA activities that can enhance levee system integrity. As part of the DRMS, **the Subcommittee recommends the articulation of a clear conceptual model of levee system stability reflecting the potential influence of water management, navigation, agricultural practice, and ecosystem restoration activities on Delta levees** to enable agencies at all levels to identify possible synergies and/or conflicts among their policies and plans.
    b. Substantial financial resources will be required to address the challenges presented by the current levee situation in a meaningful way. This raises issues of equity with respect to who benefits and who pays for current policies. The benefits of the status quo set of programs and procedures accrue to one set of stakeholders, but the costs are borne primarily by state and federal taxpayers. **The Subcommittee recommends that the fairness and feasibility of this present system of funding these programs and policies be examined by DWR as part of the DRMS. This analysis should also consider alternative mechanisms for distribution of costs.**
3. Quality of science
    a. **The Subcommittee recommends that past and present research and analysis by CBDA agencies associated with levee integrity be peer-reviewed and made broadly accessible**, including publication in the scholarly literature as appropriate. The Subcommittee also recommends that an independent peer-review process be established as part of the ongoing Delta Risk Management Study.
    b. Engage a wider range of experts including academics??

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References

Mount, J. and R. Twiss. 2005. Subsidence, sea level rise, and seismicity in the Sacramento-San Joaquin Delta. San Francisco Estuary and Watershed Science. Vol. 3, Issue 1 (March 2005), Article 5.

Torres, R., N. Abrahamson, F. Brovold, G. Cosio, M. Driller, L. Harder, D. Marachi, C. Neudeck, L. O'Leary, M. Ramsbotham and R. Seed. 2000. Seismic Vulnerabilty of the Sacramento-San Joaquin Delta Levees. Seismic Vulnerability subteam, Levees and Channels Technical Team of CALFED. 30 pages plus appendices.

Illingworth, W., R. Mann, S. Hatchett and R.Hoagland. Economic Consequences of Water Supply Export Disruption Due to Seismically-Initiated Levee Failures in the Delta. White paper prepared for DWR, February, 2005.